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OSCAR 6 LAUNCH ISSUE

Contents

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FIRST CLASS

EDITORIAL--A SEARCH FOR NEW IDEAS

By Bob Clark, WB4SMH

With the Amateur Satellite Service Committee in the final stage of organization, perhaps it is time to ask some questions that the committee (and the rest of us) might consider.

What are the goals of the amateur satellite program? Are they being fulfilled by presently programmed satellites?

A starting point in defining goals might be the statement of AMSAT purposes and objectives on the back of our membership application form. This statement stresses the goals of communication, experimentation and education--in about that order. If we polled our membership, this order of priority would probably be affirmed by a large majority. After all, we had our experimental satellite in Australis-OSCAR 5. Right now, it seems that almost everyone wants a chance to communicate, rather than experiment. One interesting exception to this trend is Joe Reymann's proposal in the Letters to the Editor section of the June, 1972, newsletter.

It seems a shame, though, that most of the emphasis in our future satellite programs is on communication. Once each of us has enjoyed that moment of immense personal satisfaction that will come from completing our first QSO via satellite--then what? That moment will easily be worth all the expense and effort we have put into assembling our stations and building the special antennas for A-O-C. But it cannot be repeated. We may get a slightly lessened thrill, again, in our first QSO through A-O-B. Again, it isn't repeatable. And for what do we use the satellites after the first contact? Two possible answers come to mind:

Contests (official or personal)
Ragchews

With our members who look forward to this prospect, I have no quarrel. If you like contests and ragchews, they provide a measure of personal gratification. For those who like the personal satisfaction that comes from successful completion of an experiment or educational effort, I have an appeal to make, and here it is:

Share your ideas with us.

Give us your thoughts on how we can accomplish the experimental and educational goals of AMSAT, as Joe Reymann and Ed Johnson did in the June newsletter. What can we do with the existing satellite programs? What future satellite concepts can you propose which would better achieve our goals? Send them to me at the AMSAT address (it doesn't have to be a formal letter--use one of your QSL cards if you wish!). I will present them to the AMSAT board of directors for examination and for submission to the Amateur Satellite Service Committee where appropriate. And I will endeavor to publish as many of the proposals as possible in the newsletter, with consent of the submitter. One example of such proposals, and an excellent approach to furthering our experimental and educational goals might be the 15-to-10 meter repeater described in "The President's Desk" in this issue. It could permit experimentation on long range low-loss modes of HF propagation through the ionosphere as well as an opportunity to study, for example, transauroral HF propagation.

Right now we need new proposals for satellites and for projects involving presently programmed satellites. This is your chance.

THE PRESIDENT'S DESK

By Perry I. Klein, K3JTE

The common question we are frequently asked is "When is the OSCAR 6 launch." It seems the answer is never definite, largely due to the uncertainties of the space business. OSCAR satellites, as we all know, are launched on a space-available, non-interference basis, an arrangement similar to riding "standby" on an airplane flight. Our satellites are piggyback payloads subject to the same delays or changes affecting the primary satellite missions with which we are riding.

NASA has now rescheduled AMSAT-OSCAR-C/OSCAR 6 for flight with the ITOS-D mission presently scheduled for launch in mid-October, instead of NIMBUS-E as announced in the March Newsletter. A-O-C had originally been scheduled for ITOS-D, but had been rescheduled to NIMBUS-E after it appeared that increases in the weight of ITOS-D had reduced the payload margin to the point that A-O-C could no longer be accommodated. Now, with the recent successful launch of NASA's Earth Resources Technology Satellite on a new upgraded version of the Thor-Delta launch vehicle, the performance of the booster has been found sufficient to launch A-O-C with ITOS-D.

The programmed orbit of ITOS-D and OSCAR 6 is as follows:

Launch Time:	1731Z ± 10 min, Oct. 11
Altitude:	790 n. mi. (910 st. mi.; 1460 km)
Period:	115.1 minutes, sun-synchronous
Inclination:	101 degrees (retrograde)
Orbits Per Day:	$12\frac{1}{2}$ (i.e., passes repeat at the same time on a two-day cycle)
Pass Time:	Around 9 AM (N-S) and 9 PM (S-N) local time, regardless of location
Sources of Orbital Data:	W1AW bulletins, AMSAT nets, and CODESTORE

John Gregory, W3ATE has been appointed AMSAT's Communications Network Manager and is responsible for the worldwide dissemination of orbital information. We expect that after the first few weeks of operation, the orbit will be known with sufficient accuracy and precision to predict passes a month or more in advance. Details on the AMSAT communications network are given later in this issue of the "AMSAT Newsletter". Please read also the article in this issue on procedures recommended for communicating through the OSCAR 6 two-to-ten meter repeater, and be sure to tear out and use the QSO/SWL reporting form and telemetry list in the center foldout of this issue.

A Proposed 15-to-10 Meter Linear Repeater

On another subject, in planning for future OSCAR satellites, it has been proposed that AMSAT fly a 15-to-10 meter linear repeater. The development of such a repeater is not difficult since much of it can duplicate the two-to-ten meter OSCAR 6 repeater design. A 15-to-10 meter linear repeater has some appealing merits. First with the approaching minimum of the eleven-year sunspot cycle, the 15 and 10 meter bands may be less and less usable for ionospheric skip communication; these bands are already generally closed during nighttime hours. Second, HF equipment is certainly available on a large scale for use in these bands. Very little additional equipment would be needed to use such an OSCAR repeater. It has also been proposed, to minimize interference from and to non-satellite users on the repeater's input and output frequencies, that the repeater be designed to automatically go into operation only when the satellite is in darkness, confining operation to local nighttime only. In addition, since free space loss is much less at 21 or 29 MHz than at 146 or 435 MHz, lower ground and satellite transmitter powers or antenna gains are required for operation. Thus, highly directive antennas are not needed, and antenna tracking is greatly simplified. Furthermore, Doppler shift is much less at HF than VHF, and therefore more easily corrected for.

The AMSAT Board of Directors would welcome your comments on this proposal. Let us hear your thoughts.

ANNOUNCEMENT OF AMSAT ANNUAL MEETING

The fourth AMSAT Annual Meeting will be held at 7:30 PM on Saturday, November 4, 1972, at the Communications Satellite Corporation (COMSAT) Laboratories in Clarksburg, Maryland, 35 miles north of Washington, DC. In accordance with the AMSAT Bylaws, election of three Directors will be held at this meeting. The agenda, in addition to the election and regular business, will include a detailed presentation on the AMSAT-OSCAR-C (OSCAR 6) mission, with recommendations and instructions on how to use the satellite. A tour of COMSAT Labs is scheduled from 5:00 to 6:00 PM. A pre-meeting filet mignon buffet dinner is planned at the COMSAT Labs cafeteria at 6:30 PM, preceded by cocktails at 6:00 PM (dinner cost is $5.50; drinks, 50¢).

Since the Annual Meeting is planned around the time of OSCAR 6 launch, all members and guests are urged to attend this meeting to get the latest details on operation with the satellite.

COMSAT Labs is located on Route 70S north of Germantown, Maryland. Take Route 70S to the Clarksburg/Boyds Route 121 exit, and go east (toward Clarksburg) 0.6 miles to Route 355. Turn right onto Route 355 and go south 0.9 miles to Linthicum Road and turn right. COMSAT Labs is located on Linthicum Road. Those equipped for two-meter FM may call in for directions on the AMSAT repeater (146.25/85) or Washington area repeaters on 04/64, 16/76 or 31/91.

It is requested that those planning to attend the dinner return the form on the last page of the Newsletter by October 30.

All member societies are urged to nominate one or two persons for election to the Board of Directors. Nominees must be members of AMSAT, but need not be members of the nominating club. The willingness to serve of each nominee must have been secured and such willingness will be assumed upon receipt of the nomination. Please forward nominations to Chuck Dorian by October 15. Include a suitable biographical sketch of each nominee.

All members who possibly can are urged to attend. If you cannot attend, please complete the enclosed proxy form and send it to the secretary, Chuck Dorian. It is extremely important that all members either attend or send in their proxies to that a quorum will be represented. Without a quorum the election cannot take place and without the election AMSAT cannot legally continue to function.

DESIGN AND OPERATION WITH THE OSCAR 6 TWO-TO-TEN METER REPEATER

By Perry I. Klein, K3JTE

Introduction

The launch of AMSAT-OSCAR-C, designated OSCAR 6 in orbit, ushers in a new era in amateur radio. For the first time, amateurs will be able to communicate through an amateur satellite available for a year or more.

OSCAR 6 contains a number of interesting systems. A telemetry system provides data on 24 spacecraft parameters, transmitting them as Morse code numbers. A message storage unit called CODESTORE* enables the loading from specially equipped ground stations of various Morse code or RTTY messages. The messages are repeated until changed. A beacon operating on 435.1 MHz aids in tracking OSCAR 6, as well as providing a signal for use in checking out receiving equipment in a frequency range to be utilized in future OSCARs.

*Both the Morse code telemetry unit and CODESTORE were designed and built by AMSAT's Telemetry System Manager, John Goode, W5CAY.

For most amateurs, probably the most intriguing system aboard OSCAR 6 is the two-to-ten meter repeater. This article is intended to provide sufficient detail on the design and operation of this device to enable amateurs to fully use its capabilities.

Development work on a linear two-meter input, ten-meter output repeater for use in OSCAR satellites began in late 1970 with the design assistance of Karl Meinzer, DJ4ZC. The repeater breadboard was completed in the spring of 1971; it is a linear frequency-translator designed to receive single-sideband and CW uplink transmissions in the frequency range 145.90 to 146.00 MHz, relaying them in the downlink frequency range 29.45 to 29.55 MHz. AM, FM, SSTV and RTTY signals can also be handled by the repeater, but with greatly reduced efficiency because unlike SSB and CW, repeater power is constantly required during all instants of each user's transmission. The use of FM with the repeater is discouraged because FM signals make very poor use of the repeater's limited power and bandwidth, reducing the number of amateurs who could otherwise use OSCAR 6 simultaneously. With minor modification on the other hand, it should be possible to key most FM transmitters so that they can be used on CW. In fact, this is perhaps the least expensive start in equipping to operate with the repeater, as two-meter FM transmitter strips are available surplus at low cost and can usually be modified readily for use on CW by keying one or more of the multiplier stages.

The Repeater Design

A block diagram of the two-to-ten repeater is shown in Figure 1. The repeater uses a 2N3478 RF transistor as a two-meter preamplifier, and another 2N3478 as the first mixer to mix the two-meter received signal down to 39.1 MHz. A 35.61625 MHz crystal oscillator output is multiplied by three to 106.84875 MHz and is mixed with the amplified two-meter signal to provide this 39.1 MHz first IF frequency. The signal is then fed to a 2N918 second mixer, which uses the 35.61625 MHz crystal oscillator a second time to mix down to a second IF frequency of 3.485 MHz, providing a gain of approximately 20 dB in the process.

The 3.485 MHz IF signal is then amplified approximately 35 dB in a single BF167 IF amplifier stage, after which it is up-converted to a frequency of 29.5 MHz in a 2N918 balanced mixer, using a 2N918 crystal local oscillator operating at 26.015 MHz. The balanced mixer achieves a gain of nearly 25 dB, and the signal level at this point is on the order of one milliwatt at 29.5 MHz. The signal is then amplified to a maximum of about 1 to 1.3 watts output using a 2N3866 driver and 2N3375 final amplifier. AGC voltage is developed in a three-transistor AGC amplifier, which senses the emitter current of the final amplifier and controls the gain of the BF167 IF amplifier.

The repeater also contains a beacon oscillator which operates at 29.45 MHz, the same frequency used by the last satellite, Australis-OSCAR 5. The beacon signal is injected at the input to the driver stage, and the beacon is keyed by the Morse code telemetry encoder or the CODESTORE message storage unit, which are selected alternately at approximately 14 to 15-minute intervals by a clock timer device in the satellite.

Using the Repeater

The repeater is designed for linear operation and is capable of handling most forms of narrowband modulation, SSB, CW, AM, FM, RTTY and SSTV. SSB and CW are recommended primary modes of operation and make most efficient use of the repeater because a number of users can operate simultaneously, each taking different proportions of the repeater's power capability at a particular instant of time. Therefore, a higher average power level is available to each user since not all CW users are key-down at any given instant, nor are all sideband stations talking up to full power at any one moment. AM, FM and RTTY do not have this characteristic. Thus, stations employing these modes will each expend the available repeater power at all times, even when no intelligence is being transmitted.

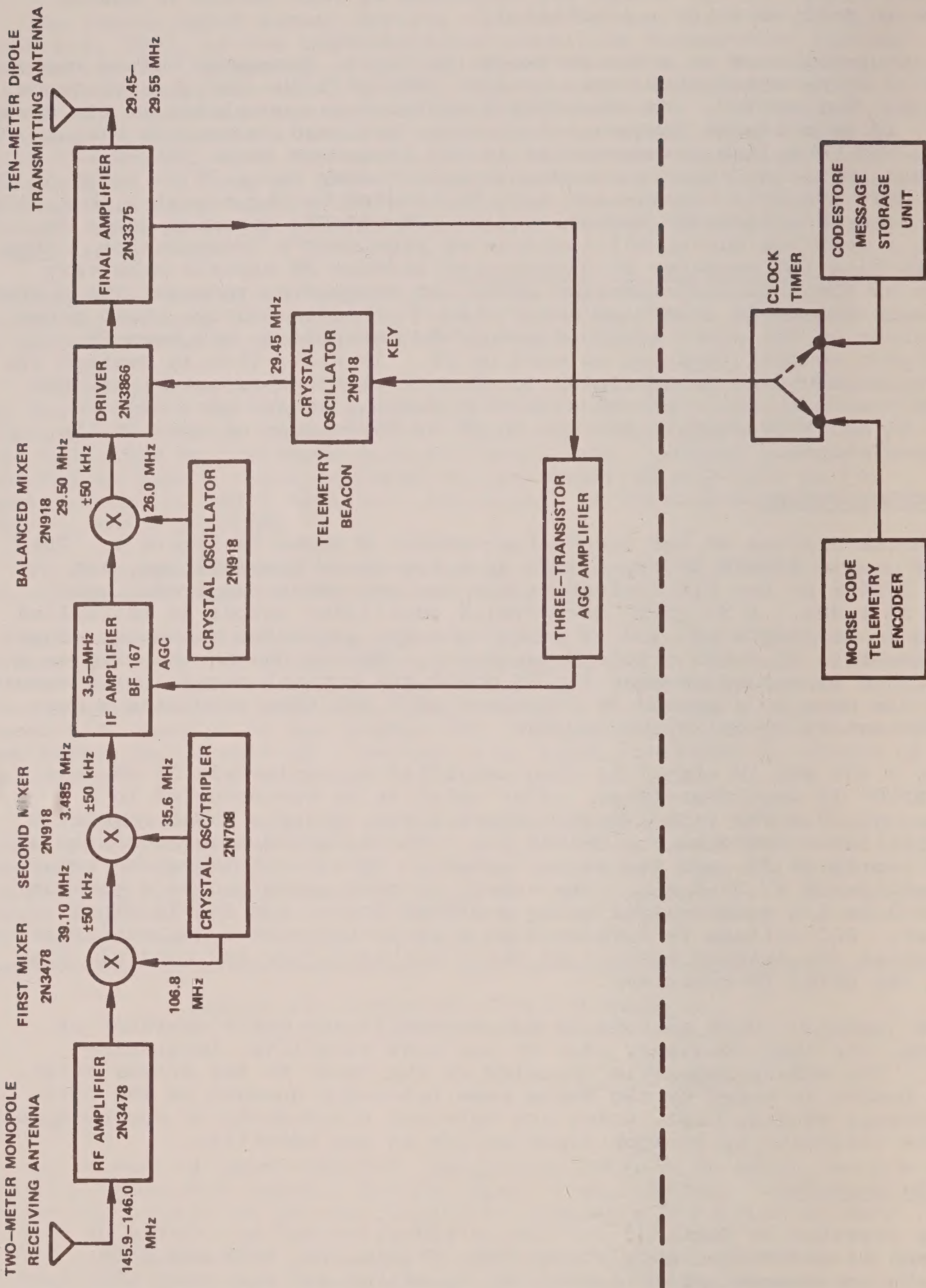


Figure 1

Block Diagram of the 2-to-10 Meter Repeater

To facilitate the most efficient operation of the repeater, all users are strongly urged to continuously monitor their own downlink signals. This is an operating technique previously rarely available to amateurs, but which enables each user to hear his own signal from the satellite as others hear it. It requires simply that a separate receiver and antenna be available for receiving one's own downlink signal on ten meters, while transmitting simultaneously on the two-meter uplink band. Such operation makes possible perfect break-in QSO's and roundtables, particularly on SSB, permitting full duplex operation. Unlike other forms of amateur communications, satellite communications with downlink self-monitoring permits each user to observe how the DX hears his signal, and he can then adjust his power and frequency to compensate for the satellite's distance and Doppler frequency shift. This is most readily done by observing the satellite's beacon signal level on 29.45 MHz and adjusting the power of the ground transmitter so that the repeated signal from the satellite appears to be the same level, either as read on an S-meter or as determined aurally. If the transmitter is VFO controlled, its frequency should be constantly adjusted by the operator while transmitting to keep the apparent downlink frequency constant in the presence of changing Doppler shift, which can be as much as $\pm$4.5 kHz for an overhead pass.

Spotting one's own downlink carrier is not always easy through the satellite repeater, and it is quite difficult to zero beat another station without careful dial calibration. One excellent method of getting a "frequency spotter" is to obtain a two-meter converter having either a 10 or 20 meter output and use it as a satellite repeater simulator in the shack. If the converter uses a 38.666 or 43.333 MHz crystal, replacing it with a 38.817 MHz crystal will convert locally generated two-meter signals in the 145.9 to 146.0 MHz uplink band to the correct frequency in the 29.45 to 29.55 MHz downlink band, so that spotting and zero beating can be accomplished without the signals leaving the shack. Figure 2 shows a block diagram of a repeater spotter for the shack. Because of Doppler shifts up to $\pm$4.5 kHz which will occur when using the actual

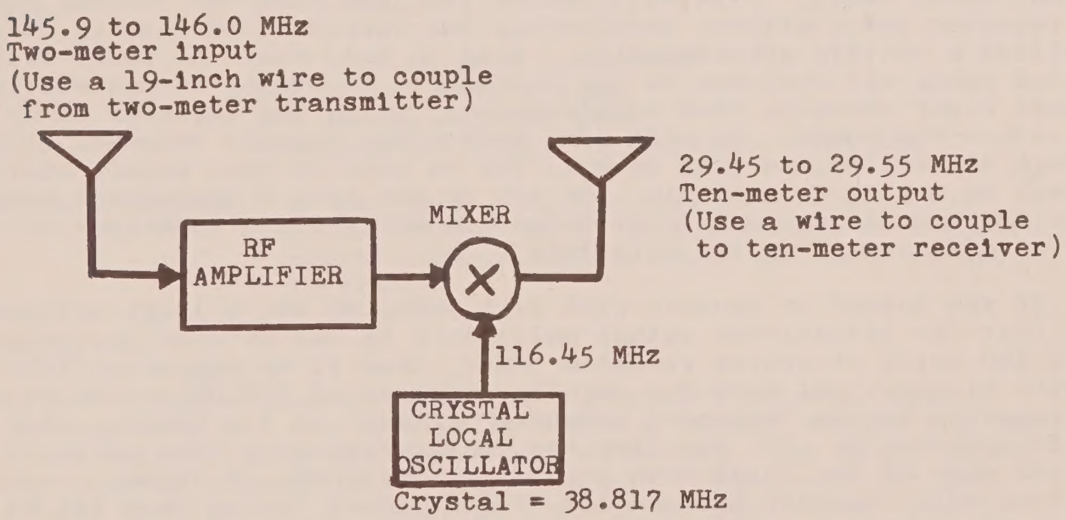


Figure 2

Two Meter Converter for Frequency Spotting

satellite repeater, the spotter's frequency will be off by the amount of the Doppler shift. This can easily be corrected for by setting the transmitter frequency several kHz higher than the spotted frequency near the beginning of a pass, or several kHz lower than the spotted frequency near the end of a pass.

Operating Procedure

The procedure recommended for operating with the OSCAR two-to-ten meter repeater is as follows:

1) When the satellite comes within range, begin listening for the Morse code beacon signal on 29.45 MHz. Be sure to note the signal strength of the beacon signal. Since the beacon is A-1 emission, use your BFO to receive it.

2) Once you have located the beacon on 29.45 MHz, tune up the band and begin looking for signals from the repeater in the 29.45 to 29.55 MHz range.

3) When you are ready to transmit, choose a frequency within the 145.90 to 146.00 MHz uplink band and send a test signal, preferably a string of dots, on this frequency (f_2). Listen for your own signal retransmitted from the satellite on the corresponding ten meter frequency (f_{10}), found from the formula:

$$f_{10} = f_2 - 116.45 \text{ MHz} \pm f_{Doppler}$$

where $f_{Doppler}$ = +4.5 kHz near the beginning of an overhead pass
= 0 kHz at the middle of the pass
= -4.5 kHz near the end of an overhead pass.

For example, a signal transmitted on 145.92 MHz will be retransmitted on 29.47 MHz $\pm$ Doppler. This is where you should listen for your signal. If you can hear your own signal, you can be sure that others can hear your signal as well.

4) Adjust your transmitter power so that on SSB voice peaks or with a slow string of dots the repeated signal is approximately equal to the beacon signal level. This will assure that you take the correct share of the repeater power without overloading the repeater and running down the satellite's battery unnecessarily. Keep in mind that the power will be divided among all stations in the passband. An overly strong station will prevent other amateurs from simultaneously using the repeater if he does not reduce his power. He will also reduce the overall repeater gain, through AGC action, so that he will not be able to hear weaker stations who may be trying to call him. If you do not have a convenient method for directly controlling your power output,an alternative technique is to aim your antenna away from the satellite.

If you intend to operate with high power or use a large antenna array such that the transmitted output multiplied by the antenna gain is above 80 to 100 watts effective radiated power, then it is suggested that you operate slightly off from the regular passband of 145.90 to 146.00 MHz. The repeater has an "extended passband" feature in its design, that is the -10 dB response is $\pm$120 kHz from the center frequency (the passband is 240 kHz wide at the 10-dB down points). Therefore, if higher power stations will transmit between 145.83 and 145.89 MHz or from 146.01 to 146.07 MHz, their signals will be compensated for by the roll-off of the repeater response, and they will not take more than the correct portion of the repeater power. One benefit for doing this is simply a reduction in QRM, since only high power stations can operate through the repeater on these extended frequency segments. Low power stations cannot easily overcome the additional attenuation of the passband roll-off and should operate in the normal repeater passband of 145.90 to 146.00 MHz.

Summary

In summary, listed below are the basic operating characteristics of the A-O-C two-to-ten meter linear repeater.

Input frequency range:	145.90 to 146.00 MHz for normal operation 145.83 to 146.07 MHz for extended passband operation
Output frequency range:	29.45 to 29.55 MHz for normal operation 29.38 to 29.62 MHz for extended passband operation Passband is non-inverting (i.e., upper sideband remains upper sideband and vice versa).
Beacon frequency:	29.45 MHz (same as Australis-OSCAR 5)
Beacon modulation:	Morse code (A-1 emission)
Repeater bandwidth:	100 kHz flat 120 kHz at 3-dB down points 150 kHz at 6-dB down points 240 kHz at 10-dB down points
Operating modes:	SSB and CW are recommended AM, RTTY and SSTV can also be used but with less efficiency FM is not recommended
Repeater power output:	1 to 1.3 watts CW into a half wave dipole
Input sensitivity:	Approximately -100 dBm (2 microvolts/m) for full output
Ground power required:	80 to 100 watts of effective radiated power produces full output from the repeater at a maximum range of 2,000 miles. (An 8 to 10 watt transmitter and 10 dB of antenna gain, or 80 watt transmitter and omnidirectional antenna should be adequate.)
Intermodulation:	20 dB down
AGC:	Up to 26 dB gain reduction 0.1 second attack time 2.2 second release time designed for highest efficiency with SSB
Ground receiver required:	Better than ½ microvolt/m sensitivity for 10 dB (S+N)/N on 10 meters should be adequate. Dipole antenna can be used, but beam is preferable.

Acknowledgments

Many of the repeater design ideas came from Karl Meinzer, DJ4ZC. The prototype repeater was constructed by Wallace Mercer, W4RUD, and the flight unit was fabricated by Richard Daniels, WA4DGU. Jan King, W3GEY provided many helpful suggestions during testing. Components for the flight unit were obtained as a result of a grant to AMSAT from Project OSCAR, Inc.

ITOS-D & OSCAR 6 NOMINAL PREDICTIONS FOR 1731Z LAUNCH TIME

NOTE: For an earlier or later launch time, subtract or add the corresponding number of minutes.

Orbit	Longitude of S/N Crossing	Time of S/N Crossing (GMT)
1	323.97° W	1841.99Z
2	352.79° W	2037.24Z
3	21.60° W	2232.48Z
4	50.41° W	0027.72Z
5	79.22° W	0222.96Z
6	108.03° W	0418.20Z
7	136.84° W	0613.45Z
8	165.65° W	0808.69Z
9	194.46° W	1003.93Z
10	223.27° W	1159.17Z
11	252.08° W	1354.41Z
12	280.89° W	1549.65Z
13	309.70° W	1744.89Z
14	338.51° W	1940.13Z
15	7.32° W	2135.37Z
16	36.13° W	2330.61Z
17	64.94° W	0125.86Z
18	93.75° W	0321.10Z
19	122.56° W	0516.34Z
20	151.37° W	0711.58Z
21	180.18° W	0906.82Z
22	208.99° W	1102.06Z
23	237.80° W	1257.30Z
24	266.61° W	1452.54Z
25	295.42° W	1647.79Z
26	324.23° W	1843.03Z

ITOS-D Orbital Elements
for Middle of Window = (1731Z)
October 11, 1972 Launch
Epoch 18h36.92min
Semimajor Axis 7839.845 km
Eccentricity 0.000257
Inclination 101.760°
Mean anomoly 265.920°
Arg. of Perigee 78.401°
Motion of Arg. of Perigee -1.9168°/day
Right Asc. of Ascending Node 297.546°
Motion of Right Ascention +0.9862°/day
Anom. Perigee 115.13799 min
Height of Period 1459.66 km
Apogee 1463.70 km
Velocity at Perigee 25676.0 km/hr.
Velocity at Apogee 25663.0 km/hr.
Geogr. Latitude of Perigee +73.539° W.
Local Time of Ascending Node 2106.07
Local Time of Descending Node 0906.06
(Longitude Increment 28.81°/Orbit)

HELIX ANTENNA GUIDELINES

By Richard L. McClain, W9MDW
K.O. Learner II, K9PVW

With more OSCAR satellites planned for the near future a high gain, directional antenna suitable for space-to-ground communication is desireable. A linearly polarized antenna is not ideal for this application because the tumbling of the spacecraft with its whip antennas causes periodic signal fading when cross polarization occurs. Crossed yagis reduces this problem but the beamwidth is narrow, dimensions are critical and impedance matching is time consuming with yagis. A better choice is the helix antenna which

has the best compromise of minimum construction costs and difficulty, high unidirectional gain, wide bandwidth and circular polarization.

After determining the dimensions of the antenna from several rather standard formulas in the appendix, the next step is to select the materials. One of the best materials for the helix conductor is $\frac{1}{4}$-inch diameter copper tubing. Another is aluminum clothesline wire which is both lighter and cheaper than copper. Two or three strands of aluminum may be twisted together to increase the conductor diameter, if desired. One problem with aluminum wire is making the electrical connection of the feedline to the aluminum conductor. Both crimping and solder intended for aluminum has been tried successfully. If you are fortunate enough to find copper ribbon, this would make an excellent conductor. Whatever the conductor material, it must be supported on some type of framework. Small lumber has been used on 432 MHz, and higher frequency helix antennas with the conductor held in place by staples. Care must be taken to prevent the conductor from becoming egg-shaped. At low frequencies with a helix of several turns, lumber is probably not strong enough for the boom. In this case, electrical conduit may be a better choice with threaded rod used with insulators at the ends to support the helix. Figure 1 shows a plastic pipe tee section used as the insulator with a hose clamp to secure the twisted aluminum wire conductor. Threaded

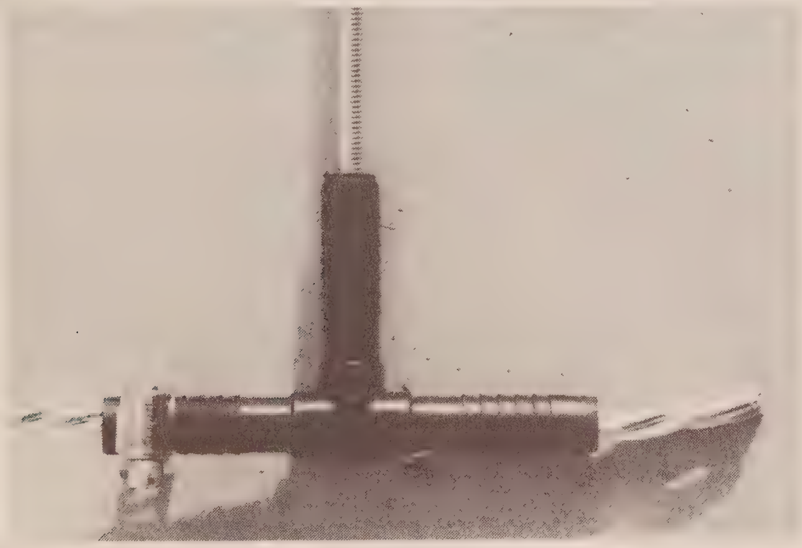


Figure 1

Plastic pipe tee used for insulator with threaded rod for standoff

rod of properly chosen diameter can be screwed directly into the base of the tee. Other insulating materials like lucite, plastic, fiberglass or even a cardboard cylinder would be excellent support for small helix antennas. A good rule to follow is to keep the material used to support the conductor to a minimum. The reflector screen material can be a solid sheet of metal but less weight and windloading can be had by using expanded metal, screen wire on a frame or just radials. The size and shape of the reflector screen can vary but approximately 0.9 wavelength diameter is common.

The biggest reason that helix antennas are not more common at UHF frequencies is the terminal impedance is not conveniently matched to standard coaxial cables. If the formulas provided in the appendix are followed by good construction practice, a terminal impedance of about 140 ohms must be matched to the feedline. Two popular methods of matching are the quarter wavelength coaxial section and a tapered line matching section. The quarter wavelength coaxial section must be constructed with its characteristic impedance equal to the square root of the product of the antenna impedance and the transmission line impedance. For example, for a 140 ohm antenna and a 50 ohm feedline the matching section must be $\frac{1}{4}$-wavelength long at the operating frequency with an impedance of 84 ohms. This is constructed by using the formula: $Z_o = 138 \log_{10} (b/a)$,, where b is the diameter of the outside conductor and a is the diameter of the inside conductor. This could be a standard piece of coax cable with the inner conductor replaced with a smaller piece of wire or a series of beer cans with a small piece of tubing centered within them by insulators providing the length and the ratio of inner to outer conductor diameters is proper. Use your imagination! Notice that the coaxial section will be a quarter wavelength long at only one frequency and limits the wide bandwidth characteristics of the helix. This may not be important for amateur work.

The other method of matching, especially with two or more helices, is a tapered line matching method which is constructed using the formula: $Z_o = 138 \log_{10} (4h/d)$, where h is the height of the conductor center from the reflector screen and d is the conductor diameter. Example: For a two helix antenna and assuming 140 ohm impedance at each helix feed point, the height of the feedpoint at the helix is found by:

$$138 \cdot \log_{10} (4h/d) = 140$$

$$\log_{10} (4h/d) = \frac{140}{138} = 1\ldots\text{(almost)}$$

$$(4h/d) = 10$$

for 0.250 inch conductor

$$h = \frac{10 \times .250}{4} = 0.625 \text{ inch}$$

At the coax end: Notice that to match two parallel terminations to a 50-ohm feedline, each termination must be 100 ohms.

$$\log_{10} (4h/d) = \frac{100}{138} = 0.72$$

$$(4h/d) = 5.2$$

$$h = \frac{5.2 \times 0.250}{4} = 0.33 \text{ inch}$$

See figure 2 for a sketch of this example. For other conditions, just plug

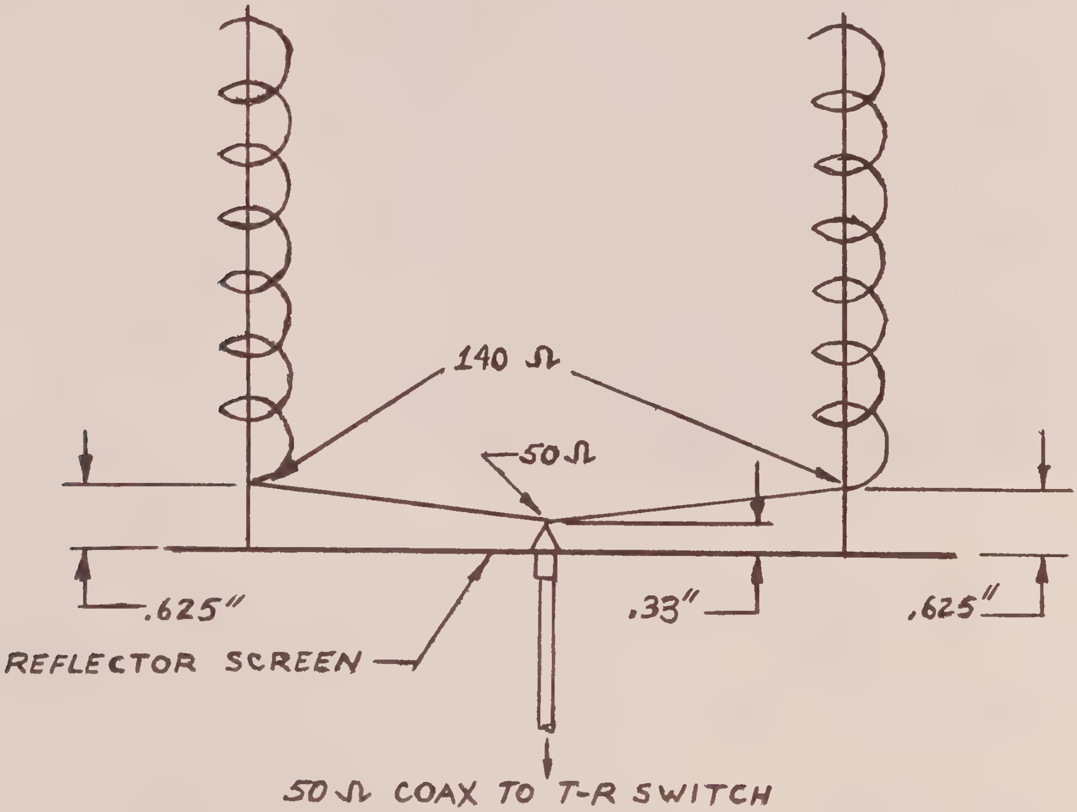


FIGURE 2. SKETCH OF TAPERED LINE MATCHING

in the appropriate numbers. The tapered lines should be equal in length and about one wavelength long. The attractive thing about the tapered line matching is that any number of helices may be easily connected to one feedline by adjusting the heights of the terminals. Also, it is not as frequency dependent as the quarter wavelength coaxial section. Keep the helices about one wavelength apart and feed them in-phase by feeding each one at similar points about the circumference of the helices.

A single ten-turn helix for 432 MHz would be about eight inches in diameter and 57 inches long. This would produce about 15 db of forward gain and a half power beamwidth of 30 degrees. Considering the simple

OSCAR 6 COMMUNICATION REPORT

Send to:
AMSAT
Telemetry Dept.
P.O. Box 27
Washington, DC 20044
U.S.A.

NAME________________________ CALL________

DATE OF REPT.____________ PERIOD COVERED________

PART I. Station Information (Fill in only if this is your first report, or if information has changed since your last report.):

Address____

Country_________ AMSAT Member?____ Source of Orbital Data________________

Latitude_____° ____min (N) (S) Longitude____° ____min (E) (W)

145 MHz Power Output________W. Antenna & Polarization________________

29 MHz Receiver______________ Antenna & Polarization________________

435 MHz Receiver_____________ Antenna & Polarization________________

Did You Hear: 29 MHz Beacon?_______(RST) 435 MHz Beacon?____(RST)

PART II. Summary of Completed Two-Way Contacts:

DATE	TIME GMT	STATION WORKED	HIS SIGNAL RST	MY SIGNAL RST	HIS MODE	MY MODE	TIME OF ENDING QSO(GMT)	COMMENTS

PART III. Summary of Amateur Stations Heard Through OSCAR 6:

DATE	TIME OF AOS (GMT)	STATION HEARD	HIS SIGNAL RST	HIS MODE	HEARD CALLING OR WORKING (CALL SIGN)	TIME OF LOS (GMT)	COMMENTS

Send to:
AMSAT
Telemetry Dept.
P.O. Box 27
Washington, DC 20044
U.S.A.

OSCAR 6 COMMUNICATION REPORT

NAME____________________ CALL________

DATE OF REPT.____________ PERIOD COVERED_______

PART I. Station Information (Fill in only if this is your first report, or if information has changed since your last report.):

Address____

Country________ AMSAT Member?____ Source of Orbital Data____________

Latitude____$^\circ$ ____min (N) (S) Longitude____$^\circ$ ____min (E) (W)

145 MHz Power Output________W. Antenna & Polarization____________

29 MHz Receiver____________ Antenna & Polarization____________

435 MHz Receiver____________ Antenna & Polarization____________

Did You Hear: 29 MHz Beacon?______(RST) 435 MHz Beacon?____(RST)

PART II. Summary of Completed Two-Way Contacts:

DATE	TIME GMT	STATION WORKED	HIS SIGNAL	MY SIGNAL	HIS MODE	MY MODE	TIME OF ENDING	COMMENTS

PART III. Summary of Amateur Stations Heard Through OSCAR 6:

DATE	TIME OF AOS (GMT)	STATION HEARD	HIS SIGNAL RST	HIS MODE	HEARD CALLING OR WORKING (CALL SIGN)	TIME OF LOS (GMT)	COMMENTS

Send to:
AMSAT
Telemetry Dept.
P.O. Box 27
Washington, DC 20044
U.S.A.

OSCAR 6 COMMUNICATION REPORT

NAME____________________ CALL________

DATE OF REPT.____________ PERIOD COVERED_______

PART I. Station Information (Fill in only if this is your first report, or if information has changed since your last report.):

Address____

Country________ AMSAT Member?____ Source of Orbital Data______________

Latitude____ ° ____min (N) (S) Longitude____ ° ____min (E) (W)

145 MHz Power Output_______W. Antenna & Polarization____________

29 MHz Receiver____________ Antenna & Polarization____________

435 MHz Receiver____________ Antenna & Polarization____________

Did You Hear: 29 MHz Beacon?______(RST) 435 MHz Beacon?____(RST)

PART II. Summary of Completed Two-Way Contacts:

DATE	TIME GMT	STATION WORKED	HIS SIGNAL	MY SIGNAL	HIS MODE	MY MODE	TIME OF ENDING	COMMENTS

PART III. Summary of Amateur Stations Heard Through OSCAR 6:

DATE	TIME OF AOS (GMT)	STATION HEARD	HIS SIGNAL RST	HIS MODE	HEARD CALLING OR WORKING (CALL SIGN)	TIME OF LOS (GMT)	COMMENTS

CODE TELEMETRY SYSTEM

meter Range	Final Calibration Data/Comments N = Value telemetered (omit first digit which identifies the data line number)
500 ma. 100 ma. 100 ma. 200 ma.	$I_T = 5.00$ N (ma.) $I_{+X} = 1.00$ N (ma.) $I_{-X} = 1.00$ N (ma.) $I_{+Y} = 2.00$ N (ma.)
194 ma. 370 ma. 370 ma. to +500 ma.	$I_{-Y} = 1.94$ N (ma.) $I_{+Z} = 3.72$ N (ma.) $I_{-Z} = 3.68$ N (ma.) $I_{BAT} = 10.00$ N -500 (ma.) Battery charge or discharge current
to 30V 15V 15V to $+50^{o}$C	$V_{BUS} = 0.174$ N $+12.4$ (volts) $V_{\frac{1}{2}BAT} = 0.161$ N (volts) $V_{SR} = 0.147$ N (volts) $T_{BAT} = -1.471$ N $+ 95.79$ (^{o}C)
to $+50^{o}$C to $+50^{o}$C to $+50^{o}$C to $+50^{o}$C	$T_{BP} = -1.471$ N $+ 95.79$ (^{o}C) $T_{PA} = -1.471$ N $+ 95.79$ (^{o}C) $T_{+X} = -1.471$ N $+ 95.79$ (^{o}C) $T_{+Y} = -1.471$ N $+ 95.79$ (^{o}C)
to $+50^{o}$C 500 ma 30V to 63.8 ma	$T_{+Z} = -1.471$ N $+ 95.79$ (^{o}C) $I_{PA} = 5.00$ N (ma) $V_{T.S.R.} = 0.30$ N (volts) $I_{I.S.R.} = 0.601$ N $+ 3.80$ (ma)
10W 1W 3V 1V	$P_{OUT} = 1.0\ (N)^2$ (mW) $P_{OUT} = 0.10\ (N)^2$ (mW) $V_{AGC} = 0.03$ N (volts) N = 50 counts ± 1

Transmitted Format (Read left to right)			
1A	1B	1C	1D
2A	2B	2C	2D
3A	3B	3C	3D
4A	4B	4C	4D
5A	5B	5C	5D
6A	6B	6C	6D

REPORTING INSTRUCTIONS FOR OSCAR 6

By Raphael Soifer, K2QBW

AMSAT-Oscar-C, or Oscar 6 as it will be known after launch, will be AMSAT's first communications satellite, and the third (after Oscars 3 and 4) to carry an amateur radio translator into orbit. It will also be the first amateur satellite launched since the creation of the Amateur Satellite Service at WARC-ST in Geneva in 1971, the first to transmit in the new allocation at 435-438 MHz, and the first communications satellite to employ a downlink in the 10-meter band. For these reasons, among others, AMSAT very much hopes that you will make maximum use of OSCAR 6 during its expected one-year lifetime--far longer than previous Oscars--and that you will let us know of your results.

Ever since the flight of Australis-Oscar 5 in 1970, questions have been flying about the ability of a 10-meter downlink to provide reliable communication, particularly during periods of ionospheric disturbance. Although the 10-meter beacon of AO-5 was quite audible just about all the time while within range, several amateurs reported considerable flutter and scintillation effects, particularly over auroral paths and during ionospheric storms. Owing to an early failure of AO-5's 10-meter modulator, we simply do not know what effect, if any, these phenomena would have had on amateur communication. The solution? Put up Oscar 6, let amateurs communicate through it, and keep track of their results!

AMSAT has developed a simple reporting form, called the "OSCAR 6 COMMUNICATION REPORT", to aid amateurs in reporting their results and thus in taking part in this very significant step forward. The report form is in three parts: Part I contains some simple questions about your station. Pertinent details of two-way QSOs made through the satellite go in Part II. Part III, on the other hand, is for reporting stations you may have heard through Oscar 6, but did not work. Let's take these parts in order.

On each report, of course, goes your name, amateur call sign, and the date on which you are submitting the report, as well as the beginning and ending dates of the period covered by the report. Each station is encouraged to submit as many reports as possible, each covering a different period in the life of Oscar 6.

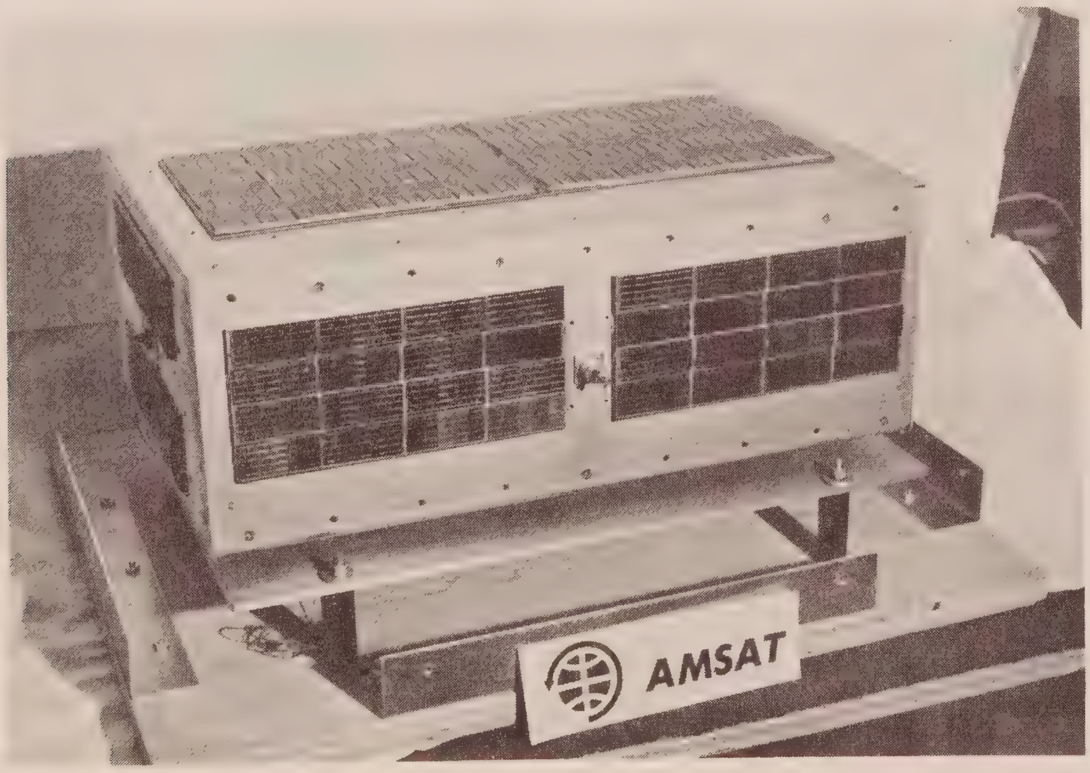
Part I, Station Information, should be completed in the first time you send in a report, and any time thereafter that the information changes, e.g., you add more power, or change your antenna, or move. If nothing has changed, it need not be filled in on second and subsequent reports. In Part I goes your address (include your ZIP code if in the U.S. and comparable mailing information in other countries if applicable), country, whether or not you are an AMSAT member (if not, we would love for you to join, but you need not be a member to submit a report and to receive acknowledgment), and the source of the orbital information with which you tracked the satellite (W1AW, GB2RS, self-generated, ZIPSAT, NORAD, etc.). Please give your latitude and longitude, in degrees and minutes, as closely as possible--since each minute is around a mile, do not worry if you are a few minutes off. For your two-meter transmitting setup, we would like to know the approximate power output at the antenna, including provision for line loss (a chart for estimating line loss may be found in the ARRL Handbook or Antenna Book). For example, a transmitter running 180 watts PEP input and 50% efficient at two meters would be delivering about 45 watts DC output (assuming 1 watt DC equals 2 watts PEP) to the feedline. Then, if the amateur is using 50 feet of RG-8/U with a 1:1 SWR, the line would give an additional line loss of 1.2 dB, reducing his DC power output at the antenna to 34 watts. It is the 34 watts we want. If you do not have exact efficiency figures, guess; you need not be "on the button" for this one! Please indicate your antenna and polarization--polarization is either horizontal, vertical or circular. It can also be elliptical, usually by accident--if yours is, either say so or fix it. For 29 and 435 MHz, we want to know the type of receiver you are using--for 435 MHz, please give the front-end tube or transistor type in your converter. Please also give the same antenna information for these bands which you gave for your 145 MHz antenna. The last line is simplicity itself--during the period covered by this report, did you hear either the 29 MHz beacon, the 435 MHz beacon, or both? If so, enter the maximum RST observed for each. No need to enter specific times of reception.

Part II is a summary of two-way contacts made through the satellite. To qualify, a QSO must be complete enough to count as a complete QSO in a contest, or for WAS--each station must receive both a complete signal report (RST) plus positive acknowledgment (R) that the other station copied his report and call sign correctly. It should go without saying, of course, that both stations must be transmitting on 145 MHz and be repeated on 29 MHz by the satellite! The requested information is largely self-explanatory and is similar to that in the ARRL Logbook--"His Mode and My Mode" simply refer to types of emission (A1, A3A, F1, etc.). We need this information to help plan future satellite projects by learning which modes give the best results. In Part III, please enter each QSO separately; if you worked the same station three times on three different passes, enter three different QSOs (three times on the same satellite pass, it is one QSO and you are becoming a DX hog!). The report form has room for 20 complete QSOs. If you make more than 20 QSOs, good for you and please send in as many forms as you need!

Part III, for stations heard but not worked, is on the reverse side of the form. To be entered on Part III, a station should be heard through the satellite but not worked by you on that particular satellite orbit. We hope that, as you tune around, you will pick up lots of stations to enter on Part III; for that reason, it contains room for 36 stations as compared with 20 on Part II. Again, the requested information is fairly self-explanatory. Time of AOS (Acquisition of Signal) and LOS (Loss of Signal) refer to the times at which you first heard and finally lost the particular station during one orbit. As with all times, it should be entered in Greenwich Mean Time. Date, likewise, is date in GMT--2000 EST, January 9th becomes 0100 GMT, January 10th. "Heard Calling or Working" refers to the station or stations he was calling or working at the time you heard him. If he was calling CQ or TEST, put down "CQ" or "TEST". If you hear both sides of a QSO, put down both stations on separate lines, as A working B and B working A, with overlapping times.

For both Parts II and III, we hope you will make ample comments, on a separate sheet if necessary. We are particularly interested in any unusual propagation you may have noticed--flutter, scintillation, or whatever, and whether it rendered communication difficult.

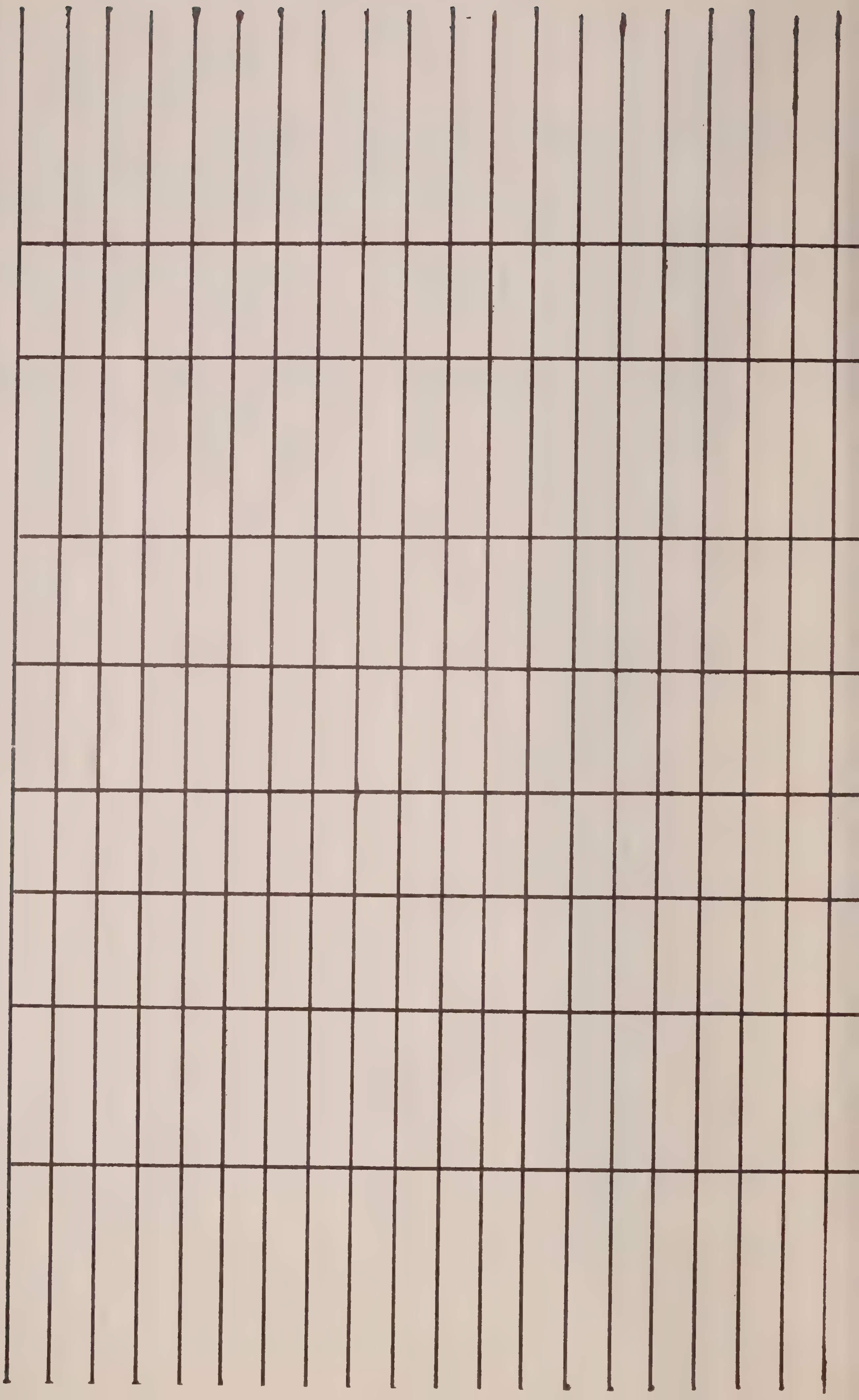
To everyone participating in the Oscar 6 effort, many thanks for your assistance and the best of DX. Please listen for me!



AMSAT-OSCAR-C (OSCAR 6)

OSCAR DATA TO BE TELEMETERED BY THE MORSE

Chan.	Parameter	Unit	Par
1A	Total Array	I (ma)	0 t
1B	+X Solar Panel	I (ma)	0 t
1C	-X Solar Panel	I (ma)	0 t
1D	+Y Solar Panel	I (ma)	0 t
2A	-Y Solar Panel	I (ma)	0 t
2B	+Z Solar Panel	I (ma)	0 t
2C	-Z Solar Panel	I (ma)	0 t
2D	Bat. Charge or Discharge	I (ma)	-500
3A	Unregulated Bus	V	12.4
3B	½ Battery	V	0 t
3C	Switching Reg.	V	0 t
3D	Battery Temp.	°C	-30
4A	Baseplate Temp.	°C	-30
4B	Transponder P.A. Temp.	°C	-30
4C	+X Panel Temp.	°C	-30
4D	+Y Panel Temp.	°C	-30
5A	+Z Panel Temp.	°C	-30
5B	Transp. P.A. Emitter	I (ma)	0 t
5C	Transp. Sw. Reg.	V	0 t
5D	Instr. Sw. Reg.	I (ma)	3.8
6A	Transponder R.F. Power	mW	0 t
6B	Beacon R.F. Power (435.1 MHz)	mW	0 t
6C	Transponder AGC	V	0 t
6D	Midrange Cal.	V	0 t



construction and low cost it becomes an attractive antenna for any UHF enthusiast and it makes power requirements for satellite work minimal. Helix antennas used for satellite work in the northern hemisphere should have right-hand polarization and those in the southern hemisphere should have left-hand polarization. When viewing along the axis of the helix from behind the reflector screen, the turns will wind clockwise as they extend away from the reflector for right-hand polarization and counterclockwise for left-hand polarization.

Appendix

Lamda = $\frac{300,000,000}{\text{Frequency in Hz}}$ = Wavelength in feet

Circumference of helix = 1.1•Lamda

Diameter of helix = $\frac{\text{Circumference}}{3.14}$

Spacing between turns = Circumference x tangent of Alpha, where Alpha is the pitch angle which normally lies between 12 to 15 degrees.
Note: The spacing will be about $\frac{\text{Lamda}}{4}$.

Diameter of the conductor = 0.006 to 0.05 Lamda

Length of conductor material = $\frac{\text{Circumference}}{\text{Cosine of Alpha}}$ x number of turns

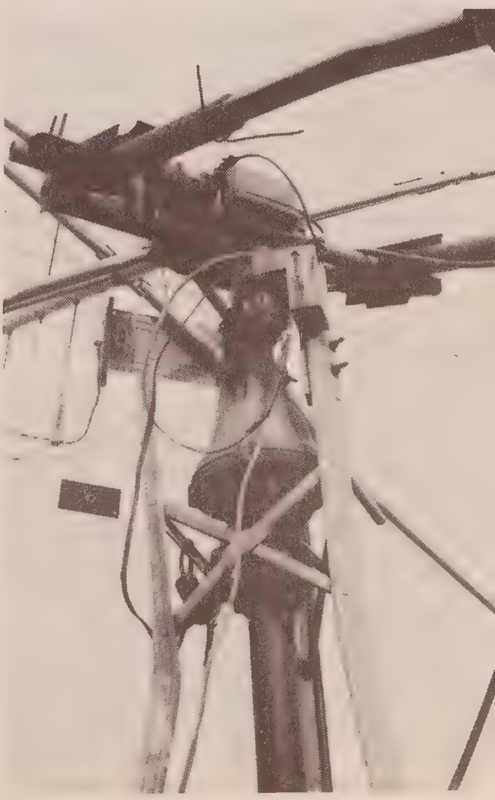
Bibliography

1) Troetschel, "A Quadhelix Antenna for the 1215-Mc. Band", QST, Aug., 1963.

2) Scott and Banta, "Using the Helical Antenna at 1215-Mc.", QST, July, 1962.

3) DeMaw, "The Basic Helical Antenna", QST, Nov., 1965.

4) Kraus Antennas, McGraw-Hill, 1951.



ABOVE: 10-turn helix for 137 MHz used at K9PVW. RIGHT: Antenna mount.

AMSAT NET-COM FOR OSCAR 6 INFORMATION

By John Gregory, W3ATE
Network Communications Manager

Now that the liftoff date of OSCAR 6 is rapidly approaching, there is a need to communicate and coordinate activities through OSCAR. For this reason, AMSAT has created a communications information network (referred to as "NET-COM"), to provide orbital data and up-to-date satellite information. NET-COM completed its first exercise September 9-10, with a dry-run communications test.

A number of primary dissemination stations are being linked together through NET-COM. These stations serve the important function of relaying satellite orbit and telemetry data to amateurs throughout the world.

Plans Following Launch

AMSAT is presently planning a daily net on 3855 and 14,280 KHz to carry up-to-date information after launch. The AMSAT Washington area repeater on 146.25/146.85 MHz will also be used, and groups in other areas are invited to use these frequencies in other locations for satellite operations traffic. It is suggested that these frequencies be standardized for relaying telemetry data and orbit information.

I have put into service a "spot-master" tape playback unit connected to a telephone, so that those interested may call for recorded information on the latest orbital, tracking and telemetry information and other items concerning OSCAR's operation. The telephone number to call in Washington, D.C. is (202) 386-4483. Call only between the hours of 2300 and 1200 GMT, as this number is used for business purposes during the day.

AMSAT NET-COM will start scheduled transmissions on Sunday, September 24, and continue every Sunday at the following times and frequencies:

1200 to 1300 GMT on 14.280 MHz SSB and 14.080 MHz RTTY (850-Hz shift)
1300 to 1400 GMT on 21.280 MHz SSB and 21.080 MHz RTTY (850-Hz shift)
1800 to 1900 GMT on 14.280 MHz SSB and 14.080 MHz RTTY (850-Hz shift)
1900 to 2000 GMT on 21.280 MHz SSB and 21.080 MHz RTTY (850-Hz shift)

Stations interested in officially participating in NET-COM dissemination are invited to let us know. Please contact me C/O AMSAT NET-COM, P.O. Box 27, Washington, D.C. 20044, and send us the following information:

1. Your name, address, station call and membership number.
2. Your station equipment (transmitter, receiver, antennas, power-inputs, bands and modes).
3. Your means for disseminating data (nets, bulletin transmissions, etc).
4. How often you will be able to disseminate data.
5. Modes of passing traffic (SSB, RTTY, CW, FM, etc.) and bands.

We are hoping as the time gets closer to liftoff and after launch that NET-COM will provide a useful source of accurate and up-to-date information for all to use.

OPERATIONS

William A. Tynan, W3KMV

Most of you are quite familiar with the procedure for working through the OSCAR 6 two-to-ten meter translator (some call it a repeater) by now, so we should not have to say anything more about that. Also, the last two Newsletters have carried articles about the AMSAT operational net. John Gregory, W3ATE, has been appointed to take charge of that particular facet of the operations responsibilty. He has an article elsewhere in this Newsletter.

Now with launch of OSCAR 6 very close indeed, let's look at a few specific ideas which have been advanced for operations-related experiments.

It has been suggested by Skip Reymann, W5SWY, that it might be feasible to communicate via teletype directly with computers through the satellite. Most computers employ eight-level ASCII code rather than the five-level Baudot code used by amateurs for RTTY. In order to communicate with a computer, one or two methods can be used. Either a conversion from five to eight-level code must be made at the receiving end, or eight-level code must be used at the transmitting end. The latter is probably the better solution but requires two things. First, an eight-level machine must be used, and second, and very important, a waiver of the FCC rules must be requested to allow use of the eight-level code on the amateur bands. The rules state that five-level code be used by amateurs for RTTY. W5SWY has requested such a waiver and is looking for other amateurs, particularly those with access to computers, to do the same. Incidentally, the same kind of communication could also take place on HF. Appropriate subjects for such work would be satellite orbital computations and processing of telemetry data. We will be watching these experiments with great interest.

An idea, suggested for CODESTORE, was mentioned in the last Newsletter. It involves the storing of bits in such a sequence that when speeded up by a factor of four and used to key an audio oscillator (or two oscillators) to produce the proper tones for an AFSK RTTY terminal unit, teletype copy is produced. Naturally, CODESTORE will normally be operated in its originally intended mode of reproducing Morse code messages, but the RTTY mode will most certainly be tried. Just how often will depend on the number of amateurs who equip themselves to decode such transmissions.

Shelly Glick, WA1IUO, has suggested an experiment which might be conducted between repeater stations, which are popping up everywhere in Germany, Australia and other countries as well as all over the U.S. Wouldn't it be exciting and noteworthy if two hand-held transceivers could be used to communicate across the country through the OSCAR satellite. This could be done if suitable satellite communications equipment is installed at two repeaters through which the hand-held units work. We have been giving some thought as to what constitutes suitable equipment and what frequencies to suggest for such operation.

Almost all repeaters use FM and we know, from last year's aircraft test flights and other observations, that FM is not an optimum or efficient manner of using the satellite's two-to-ten meter translator. The same goes, to a somewhat lesser extent, for normal AM. The main problem with these modes is that, because of the steady carrier involved, they take up translator power even when no intelligence signal is present, e.g., between words. On the other hand, SSB and CW do not have this characteristic. Controlled carrier AM, with about a 10 dB ratio between modulation peaks and residual carrier level might also be an appropriate mode for use through the satellite. The principal difficulty with using SSB to communicate between repeaters through the satellite is Doppler shift. For manned stations, this can be taken care of simply by tuning the receiver, but many repeater installations are not very accessible. It is proposed, therefore, that for this type communication, controlled carrier AM transmitters of about 100 to 200 watts peak power be used. The transmitter could be activated by tone or whistle and shut down with a timer. It should <u>not</u> be activated every time the repeater is used for normal terrestrial communication.

What about a specific designated frequency? First, it is felt that it should be below 146 MHz so that repeaters throughout the world can avail themselves of the mode (only the 144 to 146 MHz portion of the two-meter band is assigned to amateurs on a worldwide basis), and in order to not cause interference to normal terrestrial repeaters in the U.S. which use frequencies down to 146.01 MHz. Secondly, it should be a frequency just outside the central 100 KHz passband of the translator, so as to free the main portion of the passband for use by individual amateurs. The passband is actually 240 KHz wide to the -10 dB points. What this boils down to is that an uplink frequency of 145.885 MHz is suggested. This will provide sufficient separation from 145.90 MHz which would cause interference to the beacon on 29.45 MHz. The 10 meter downlink frequency which corresponds to 145.885 MHz is 29.435 MHz. Each repeater used to communicate through the satellite would, of course, have to have a receiver on this frequency. Possibly AFC could be used to compensate for Doppler; the receiver might simply be made broad enough to copy the controlled carrier AM signal in the presence of Doppler-shift.

The new FCC rules relating to repeaters specify that two-meter repeaters may only operate between 146 and 148 MHz. Therefore, a special waiver would have to be obtained in order to use the suggested frequency. The rules also state that only a single signal shall be radiated on a band at a time. Since it would be desirable to operate the regular repeater transmitter and the satellite uplink transmitter simultaneously, a waiver of this provision would also be necessary. Also, the new provision prohibiting repeating from one band to another must be waived in order to permit repeating the satellite's downlink transmissions on 29.435 MHz at VHF.

Since the repeater location is assumed to be unmanned, a non-directional antenna of some sort must be used for up and downlinks. This, coupled with the fact that the suggested frequency is on the skirt of the translator's bandpass, indicates that a peak power of about 100 to 200 watts will be required.

It will be interesting to see how this idea develops. Let's hear your thoughts.

Speaking of repeaters, specifically the FM variety, AMSAT's Washington area repeater will be on soon. It will be 25/85 (146.25 input, 146.85 MHz output). AMSAT members from out of town visiting the nation's Capitol with FM gear are encouraged to equip themselves for this frequency combination. It would also facilitate matters if areas outside Washington in which a number of AMSAT members, or other groups involved in amateur space activities, were to use the same repeater input/output pair. In this way, we would be able to communicate with each other when visiting one another's cities without having to buy extra crystals which would be of no use at home.

CU THRU OSCAR

73,
Bill

A SIMPLE APPROACH TO OSCAR COMMUNICATIONS CALCULATIONS

By Carl W. Brown, W3LUL

With the launching of OSCAR 6 providing potential two-way satellite communications for the amateur, it becomes desirable for the serious participant in this mode to have available a simple technique for determining the mutual communication times between himself and other stations as well as the changes in beam headings during the pass. The method to be described permits the amateur to home-brew his own information from materials that are readily available. Satellite rise and set times derived are accurate to better than one minute. Vagaries of propagation are often worse than this. This technique is equally usable in both hemispheres or on the equator using only a single chart. The method is an outgrowth of a "quick and dirty" scheme to provide information on the times of passes of the previous Australis-OSCAR 5 over the principal cities of the world.

The technique involves plotting the satellite orbit on one piece of paper and the geographical locations of your station, the cities of interest, and your OSCAR receiving horizon on another. If one sheet is transparent then the two sheets can be aligned along the equator and the orbital plot moved to coincide with the equatorial crossing data supplied from W1AW bulletins and other sources. In fact, once a single pass has been acquired it is possible to do your own predictions for several days in advance. Although almost any pair of matched coordinate sheets could be used, a rectangular grid system was selected for this project rather than the fancy projections (of the earth) used by map makers, because the latter type of paper is not readily available. Data for plotting the orbit are taken from QST for October 1969, page 56, Table I. Although these preliminary Australis-OSCAR 5 data differ slightly from the true orbital time of 115 minutes duration and 388.8 degrees longitude advance for one revolution expected for OSCAR 6, the resulting errors are insignificant. An atlas provides the information on latitude and longitude for locating the cities of interest.

Finally, unless one is mathematically inclined, a globe provides the easiest method of obtaining the geographical coordinates and directions to the horizon over which the satellite rises and sets at a particular location.

For the orbital data plot, a medium weight of paper stock, cross-ruled four lines to the inch with every fourth line heavy, is used. From the data table in the QST aforementioned article it is noted that the orbit carries the satellite to nearly 80 degrees of north and south latitude, while one revolution advances the longitude 389 degrees west (2 x 194.5 degrees). By choosing a scale factor of 20 degrees per inch, the minimum dimensions of this sheet for plotting one revolution are $8\frac{1}{2}$ x 22 inches. This permits the inking of one heavy line in the 22-inch direction as the equator and still having four inches of rulings above (north) and below (south) of the equator. Likewise, two inches of extra space are available at each end of the sheet beyond the 0 to 360 degrees length of the equator. Longitude values are labelled at 20 degree intervals along the equator, starting with 0-degrees at two inches from the right hand edge and progressing westward (to the left) through 360 degrees to 20. Also ink vertical (meridian) lines at 0, 180, 360. Label the north and south latitudes along the edges at 20 degree intervals from the equator. Now plot the orbital data from the aforementioned table and connect the points with a smooth curve. Ink this curve for easy visibility through the transparent overlay which is to be prepared next. At right angles to the orbital path make light-weight lines at the points of two-minute time intervals.

The accompanying figure uses dashed lines rather than solid ones to distinguish the orbit as being plotted on the under sheet. The use of the time marks is evident. Be sure to label all values of time throughout the full 114 minutes (actual 115) of one revolution, starting with zero at the moment the satellite crosses the equator headed in a northerly direction. Data in the table are given for only the northern half of the revolution. However, the orbit is symmetrical so the plot of the southern hemisphere can be continued by reusing the same data again, but this time considering the latitude as south. Remember that adding even increments of time to 57 minutes lapsed time at the end of the first half of the orbit causes the time marks in the southern hemisphere to have odd values. If even values are desired one can always start at the 389 degree end of the orbit and plot the data going eastward along the equator.

It may be convenient to make additions to the plot. For example, the orbit can be extended backwards from zero into the southern hemisphere as shown in the figure. Also, for ease in predicting the next pass it is desirable to have that part of the orbital data beyond 360 degrees repeated on the right hand side of the page as is shown. Note that the next crossing of the equator is 29 degrees farther west than the previous orbit (actually 28.81 degrees).

The transparent overlay sheet with the geographical data is a similar size, or longer, page with faint rulings also at the quarter-inch intervals. In the absence of a single sheet of this size, a suitable substitute can be made by splicing together with transparent mending tape three pieces of $8\frac{1}{2}$ x 11" paper, such as fade out sketching paper. Be sure to register the major ruled lines if they are present. Unruled paper may be used just as easily if the orbital sheet with its grid markings is held precisely to this sheet during this construction and city location process. Ink the equator line to match the first sheet and rule off meridian lines at 0, 180, and 360 degrees of longitude as before. For maximum utility some may find it desirable to shift the coordinates of this page so as to have their own QTH at least 90 degrees from the edge. Label at 20 degrees intervals as before. From an atlas, select the geographical coordinates of the cities of the world which may be of interest and locate them on this overlay. No other geographical features are of interest so the distortion of this map is not evident. Be sure to include your own QTH. Values to the nearest whole degree provide adequate accuracy.

The next item to include on this sheet is the location of the horizon over which the satellite rises and sets at your QTH. For the sun-synchronous orbit of ITOS-launched OSCAR's this horizon is a circle (on the globe)

located 2135 nautical miles from you. Nautical miles are used because each nautical mile is one minute of great circle arc, which means that there are 60 nautical miles per degree at the equator. Thus, this boundary is a line 35.5 great circle degrees distant. Since most of us live at middle latitudes the use of rectangular coordinate paper causes this circle of our horizon line to be quite distorted on this overlay. This can be seen from the figure. The only two easy points on this circle are those 35.5 degrees north and south of us on the meridian passing through our location. Locating the other points of this circle requires the assistance of a globe and compass. Adjust and secure the span of the compass to measure exactly 35.5 degrees along the equator of the globe. Then, with the compass centered on your QTH, scribe a circle on the globe. Make a table showing the latitude and longitude of each intersection of this circle with a major meridian or latitude line on the globe. Plot these data on the overlay. Connect all points with a smooth line. This is your listening horizon and any time the satellite passes inside this boundary it should be heard. A section of the overlay showing the satellite horizon for the writer is included in the figure as one of the solid lines. Note the severe distortion of the circle at higher latitudes.

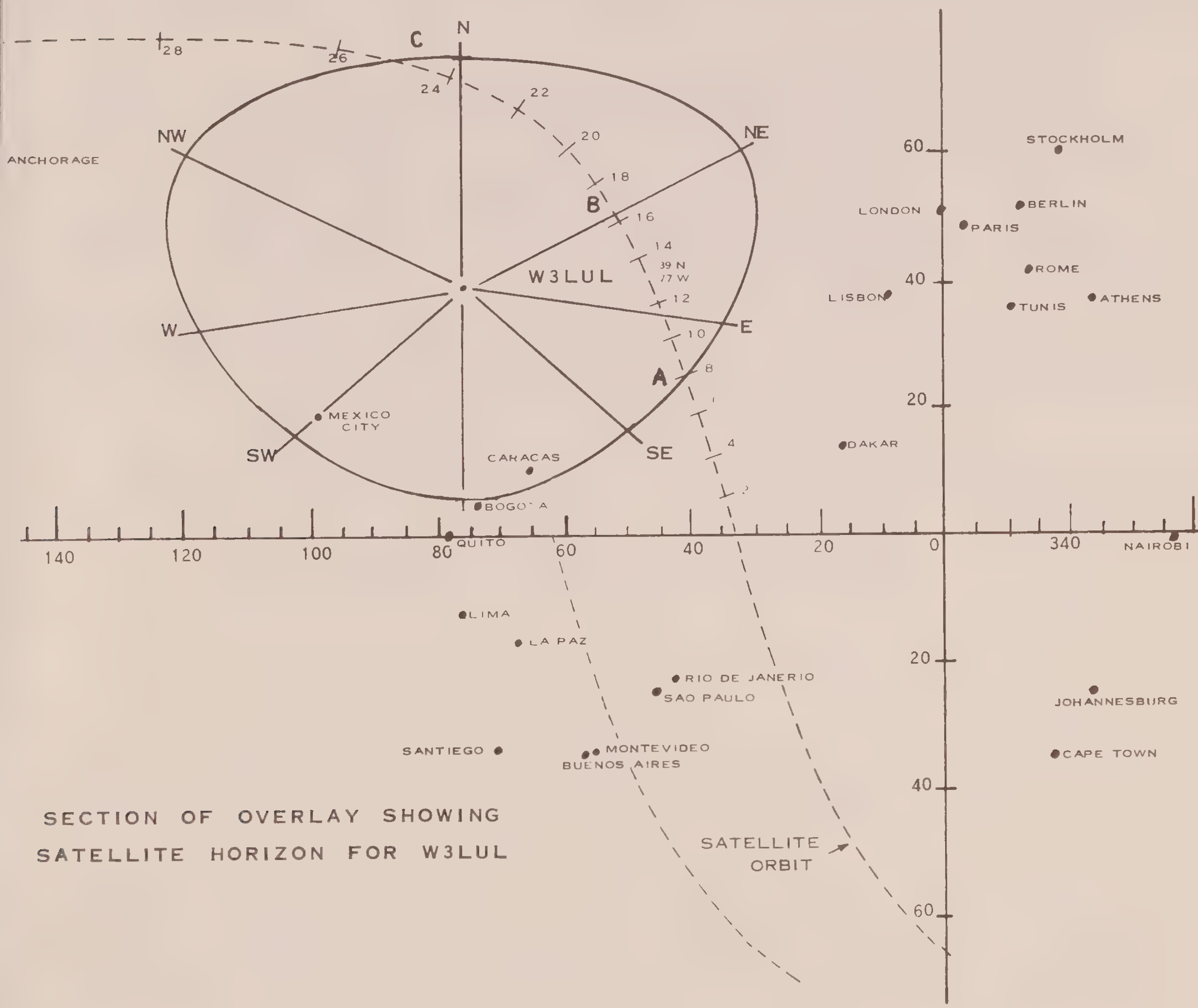
Because of the narrow patterns of VHF beams, it is necessary to include beam pointing data. Use a rubber band or other aid to establish an east-west great circle through your QTH on the globe. Note the positions of intersection with your horizon line. Mark these same coordinates on the overlay as E and W. Remember that if you live at 40 degrees of latitude this intersection does not fall on the 40 degree latitude line but is near 35 degrees. An east-west line connecting your location with these points on this chart would be a curved line; however, for most of us a straight line is an excellent approximation. As a minimum, locate these beam heading designations around the horizon line at 45 degree intervals. For the fellow with elevation pointing capability, additional contours within this circle would be desirable. Elevation data versus distance are given in Figure 2 of the same QST article used for the orbital data. Before making suggestions on how to establish QSO's beyond the horizon it is best to first learn the basic use of this tool.

The W1AW bulletins and other sources will provide the time of south-to-north crossings of the equator for each revolution of OSCAR as well as the longitudinal position of this crossing. Position the transparent geographical data overlay on the orbital plot, keeping the equator lines aligned at all times. Slide the overlay until its equatorial reading coincides with the orbital track of the underlay sheet at the crossing value given by the W1AW bulletin for that revolution. If any part of the orbit crosses inside your horizon circle, communication through the satellite is possible. The time of satellite rise is obtained by adding to the given bulletin time the minutes along the orbit from the equatorial crossing to the intersection with your horizon. The time of satellite set is obtained in a similar manner except that it is the moment when the orbit passes beyond your horizon.

In the accompanying figure, a portion of the orbital underlay (without grid lines) is shown as dashed lines, while the geographical data on the transparent overlay is shown in solid lines. In this example, the bulletin data stated that this revolution crosses the equator at 33 degrees west, and the two charts are so aligned. One can observe that 8 minutes later, at point A, OSCAR rises for initial reception by W3LUL at an antenna heading of about 110 degrees. At point B, $16\frac{1}{2}$ minutes after crossing the equator ($8\frac{1}{2}$ minutes from initial contact) the direction of OSCAR is 45 degrees. Finally, at point C, 25 minutes from the equator (17 minutes after initial reception) contact ends at a bearing of about 345 degrees because the satellite passes outside the coverage circle. From this example, the importance of directional data should be evident, both for initial acquisition and updating of pointing information during the pass. The next pass 115 minutes later will cross the equator near 62 degrees west, (29 degrees west of the pass just described (33 + 29 = 62). This time, if the overlay were shifted, it would show OSCAR rising over the southerly horizon and passing directly overhead. This suggests the need for adding elevation pointing capability. It should also be noted that at least three consecutive orbits are available for QSOs. Stations located in the higher latitudes have access to more passes.

Each station has its own distinctive horizon. For QSOs between two stations the satellite must be mutually visible to both. Therefore if contact with a specific station is desired a horizon circle must be prepared for the other station. For communication, the satellite trajectory must pass through this overlapping area of the two circles. For a station on the equator, such as at Quito, a circle of 35.5 degrees scribed with a compass would be an adequate approximation. If the other station's latitude is about the same as yours then it would suffice to trace your circle on another piece of transparent paper, mark the north-south line, cut it out and then center it on the station of interest. For example, the circle for W3LUL would also suffice for Lisbon. It should be noted that only a brief contact would ever be possible between the two locations. A momentary contact with Dakar would also be possible for the pass shown. On the next revolution Caracas would provide a potential communications window of 10½ minutes, and Quito should be available for 8 minutes. Lima and La Paz offer brief possibilities. Remember that passes in the opposite direction, north to south, occur about 12 hours later.

In the absence of an aid like the one just described it would be difficult to make skeds for QSOs through OSCAR. Of course, one can always take pot luck, or tail-end the more competent stations in your area, assuming that they are kind enough to tell you where to point your antenna.



SECTION OF OVERLAY SHOWING SATELLITE HORIZON FOR W3LUL

REPORT OF THE AMATEUR SATELLITE SERVICE COMMITTEE

June 24, 1972

Representatives of AMSAT, OSCAR, and A.R.R.L. met on June 23-24, 1972, in Washington, D.C. to establish a formal working committee to plan, guide and coordinate activities of the Amateur Satellite Service. Interim membership of the new group includes:

Victor C. Clark, W4KFC
Richard Daniels, WA4DGU
Harry J. Dannals, W2TUK
William W. Eitel, WA7LRU/W6UF
Perry I. Klein, K3JTE
Ray Vincent, WA6CBX

Also participating in the meeting were John Huntoon, W1RW, Jan King, W3GEY, and Bill Dunkerley, WA2INB. Interim chairman of the committee is William W. Eitel, WA7LRU/W6UF. Permanent members and chairman are to be selected at a later date. Objectives of the group will include selection and articulation of desirable goals for the Amateur Satellite Service and the marshalling of necessary resources to enable their successful realization.

The following positions were adopted by the committee:

1. The committee endorses the currently-active phase of the Amateur Satellite program, i.e, to assemble, test and launch AOC, and to continue development of the AOB series of satellites.

2. The requirement for additional funding for this undertaking (in the amount of approximately $5000 for the balance of calendar year 1972) is recognized and acknowledged by the committee. This will be met through a special fund-raising effort by AMSAT.

3. The committee agrees (a) that AMSAT and OSCAR should pursue individual, but cooperative, efforts to identify and study possibilities for launch opportunities, and (b) assist in securing surplus hardware and donations of components to support the current AOB and AOC programs.

4. OSCAR and AMSAT members of the committee will jointly review and evaluate the Syncart/Spirit of '76 proposals and develop a coordinated plan of action for submission to the committee as a whole not later than July 30, 1972.

5. The Committee will assume responsibility for:

(a) Developing plans for funding of satellite projects.
(b) Coordinating and helping to arrange staffing of projects (including volunteer and salaried personnel).
(c) Advising on international and domestic regulatory matters affecting the Amateur Satellite Service.
(d) Planning and organizing programs for the public service application of amateur satellites (particularly with regard to education, emergency service and international applications).

The committee and other participants in this initial meeting reviewed and compared in considerable detail the various aspects of the Syncart and Spirit of '76 proposals of AMSAT and OSCAR, respectively. Also discussed at length were the roles of the various participants in the new committee and methods of achieving committee goals. It was agreed that, insofar as possible, committee meetings will be held in the Washington, D.C. area.

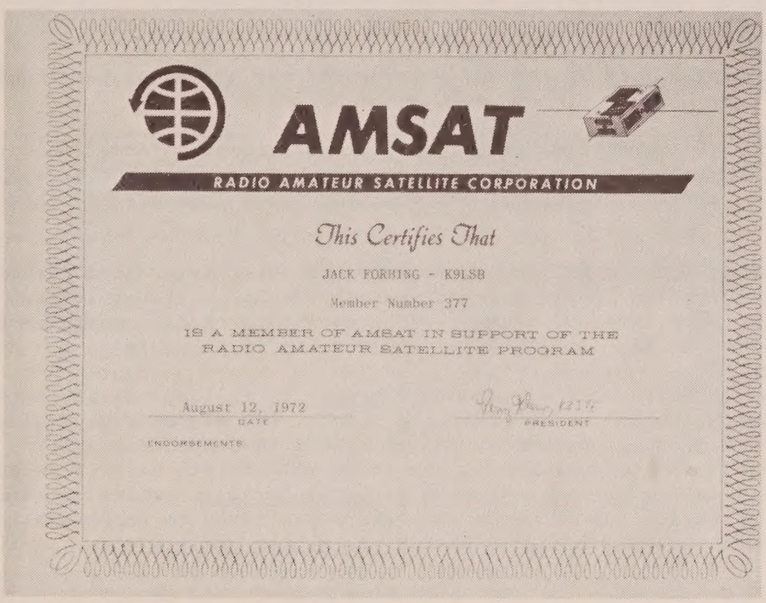
Respectively submitted.

William W. Eitel, WA7LRU/W6UF

Interim Chairman

AMSAT MEMBERSHIP CERTIFICATES

AMSAT now has a membership certificate. It is suitable for mounting in an 8 x 10" frame and carries the member's name, call, member number and date issued. The lower portion has space for attachment of endorsements certifying participation in AMSAT-OSCAR communication activities. New members and new AMSAT member societies are being issued the certificate upon receipt of their application form and dues ($5.00 individual, $7.00 family and $10.00 club). Present members will receive a certificate upon their renewal. Early renewals are accepted at any time if you need to cover that bare spot on the wall in a hurry. Membership cards will be issued upon renewal in subsequent years.



AMSAT DONORS

AMSAT gratefully acknowledges recent donations from the following members to assist with the AMSAT-OSCAR-C and AMSAT-OSCAR-B projects:

Dexter Anderson, W2YLN/K3KWJ
F. Doug Armes, K4RX
James C. Carroll, W4COM
Ronald W. Cox, W9KFB
H.L. Crispell, W6TZV
Mr. & Mrs. William Eitel, WA7LRU/W6UF & WA7LUN
David G. Flinn, WB2QGK/W2CFP
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Donald B. Whittemore, W2CUZ

RADIO AMATEUR SATELLITE CORPORATION
P. O. Box 27
Washington, D. C. 20044 USA

The Radio Amateur Satellite Corporation is a non-profit, scientific corporation founded in the greater Washington, D. C. area. The purposes and objectives of the Corporation are:

A. To provide satellites that can be used for amateur radio communication and experimentation by suitably equipped amateur radio stations throughout the world on a non-discriminatory basis.

B. To encourage development of skills and the advancement of specialized knowledge in the art and practice of amateur radio communications and space science.

C. To foster international goodwill and cooperation through joint experimentation and study, and through the wide participation in these activities on a noncommercial basis by radio amateurs of the world.

D. To facilitate communications by means of amateur satellites in times of emergency.

E. To encourage the more effective and expanded use of the higher frequency amateur bands.

F. To disseminate scientific, technical and operational information derived from such communications and experimentation, and to encourage publication of such information in treatises, theses, trade publications, technical journals or other public media.

Membership in AMSAT is open to all radio amateurs and other interested persons. AMSAT encourages the participation of all interested individuals in its activities regardless of membership and invites licensed amateur radio operators of all countries to engage in radio transmissions to the satellite(s). Membership is possible in two categories:

A. An interested individual may become a Member by filling out and returning the membership application on the reverse side, along with his dues payment.

B. A recognized group or organization interested in supporting AMSAT's goals and objectives and wishing to participate constructively in its activities may become a Member Society by completing and returning a Member Society application together with their dues payment. This class of membership was established to encourage interested groups to participate in AMSAT projects within the Member Society's own area of interest.

An annual financial contribution is requested from Members and Member Societies in an effort to offset the costs of printing and mailing newsletters. This donation may be waived at the discretion of the Board of Directors. Donations are tax deductible.

Members of AMSAT are entitled to

A. The opportunity to participate in the activities of AMSAT and to vote in the elections for the Board of Directors.

B. Receive newsletters and other information which may be generally distributed by AMSAT.

C. Be acknowledged as supporting the activities of AMSAT with a membership certificate or card.

Member Societies of AMSAT are entitled to

A. Participate in AMSAT's activities.

B. Nominate two Members per annum as candidates to the Board of Directors.

C. Receive newsletters and other information which may be distributed by AMSAT.

D. Be acknowledged as supporting AMSAT's activities with a Member Society card or certificate.

AMSAT

RADIO AMATEUR SATELLITE CORPORATION
P. O. Box 27, Washington, D.C. 20044 USA

MEMBERSHIP APPLICATION

Name ______________ Call ______ Class of License ________ Home Ph. ________

Street ______________ City ____________ State ________ Zip ________

Employer ______________ Position ______________ Bus. Ph. ________

Bus. Address ______________________________________

ARRL Member? ☐ Yes ☐ No. Club Affiliations ______________________

What Bands and Modes are you active on? ______________________

Education ______________________________________

Are you willing to accept an assignment within your field of interest? ☐ Yes ☐ No.

Please indicate how you can help AMSAT. ______________________

MEMBERSHIP QUESTIONNAIRE (OPTIONAL)

PLEASE INDICATE BELOW AREAS OF POSSIBLE CONTRIBUTION (Check those which apply.)

Engineering

- ☐ Prel. Design
- ☐ Antennas
- ☐ Tracking
- ☐ Power Systems
- ☐ Telemetry
- ☐ Structural Design
- ☐ Fabrication
- ☐ Drafting
- ☐ Other ______________
- ☐ Circuit Design
- ☐ Data Proc.
- ☐ Stabilization
- ☐ Testing
- ☐ Packaging
- ☐ Data Acquisition
- ☐ Data Dissemination

Administration

- ☐ Ext. Relations
- ☐ Library
- ☐ Fund Raising
- ☐ Data Processing
- ☐ Legal
- ☐ Editorial
- ☐ Liaison with ________
- ☐ Other ________
- ☐ Tech. Writing
- ☐ Clerical/Sec.
- ☐ Printing/Repro.
- ☐ Photography
- ☐ Accounting
- ☐ Publications
- ☐ Tech. Translation (indicate languages) ________
- ☐ Education

Please describe experiments you believe AMSAT should undertake. ______________________

I understand that the statements made hereon are for the exclusive use of the Radio Amateur Satellite Corporation and will not be released to other agencies. I further understand that it is my responsibility to insure that only information which my employer does not consider proprietary will be released to AMSAT.

I hereby apply for membership in AMSAT. Attached is $5.00 to cover the first year's dues. (Donations above this amount are tax deductible.) (Dues may be prepaid for any number of years.)

Signed ______________________ Date ______________

Form 1 (rev. 3/71) N/L 9/72

FOR OFFICE USE ONLY
Pd ________ Cd ________ Cdd ☐ Dpl ☐

FOR OFFICE USE ONLY
NAME ________ CALL ________ LIC. A B ARRL C D Act. E F Eng. G H Exp. ________

ATTENTION MEMBERS!

FOURTH ANNUAL MEETING - SATURDAY, NOVEMBER 4, 1972

Please complete and return the following, whether or not you can attend the meeting. For dinner reservations, this form should be returned by October 30. Mail to:

AMSAT Annual Meeting
Post Office Box 27
Washington, DC 20044

NAME & CALL ______________________________

ADDRESS ______________________________

____

Check X to indicate "yes":

( ) I plan to attend the Annual Meeting

( ) I plan to participate in the tour of COMSAT Labs

( ) I will be present for the dinner. Please make ____ reservation(s).

( ) I would like transportation from ______________________

______________ at __________ o'clock.

( ) I need accommodations for ____ persons on __________ dates.

( ) I cannot attend the Annual Meeting

( ) I may be able to attend, but am not sure

______*______*______*______*______*______

PROXY FORM

If I, ______________________________
(Print Name and Call Letter)

cannot attend the AMSAT Annual Meeting, then I authorize the following individual to vote in my place:

( ) Charles Dorian, W3JPT, AMSAT Secretary

( ) Other (Name and Call Letter) ______________________

Signature ______________________

Membership No. ______________________

Date ______________________